



Assessing Otolith-Organ Function with Vestibular Evoked Myogenic Potentials (VEMPs) in Parabolic Flight

Problem Statement

- Research gaps identified by the NASA Human Research Program: SM2: What are the changes in sensorimotor function over the course of a mission? SM26: Does exposure to long-duration spaceflight lead to neural structural alterations?
- Our technology addresses this by testing a muscle response that is directly driven by the gravity-sensing part of the vestibular system (the otolith organs).
- Parabolic flights provide space-relevant g levels for testing, and induce sensorimotor changes similar to those of space flight.
- Potential users: NASA astronauts, flight surgeons. Eventual plan is to use this technology on ISS.

Technology Development Team

- PI: Mark Shelhamer, Johns Hopkins University School of Medicine, mjs@dizzy.med.jhu.edu
- Kara Beaton, John Carey, JHU
- Funding: internal.
- Technology partners: none.

Proposed Flight Experiment

Experiment Readiness:

- Ready for flight March 2013.

Test Vehicles:

- Parabolic aircraft.

Test Environment:

- Testing is requested in 0g and hyper-g, and is helpful in all available g levels (lunar, Martian).

Test Apparatus Description:

- Tablet computer: controls stimulus and recording, guides user through protocol and accepts input through touch screen.
- Wireless EMG sensors, electrodes: record subject muscle activity.
- Headphones, reflex hammer or automated vibrator: applies sound or tap stimulus.
- Auditory clicks or forehead taps are applied to the subject, the resulting vestibular stimulation induces reflexive activity in the neck and eye muscles.



Technology Maturation

- Current TRL: 4 *component validation in laboratory environment*.
- TRL 5 *component validation in relevant environment* – flights in early 2013 to verify components for VEMP stimulation/recording, user interfacing.
- TRL 6 *system demonstration in relevant environment* – flights in late 2013 with final integrated hardware & software; modifications based on previous flight experience.
- TRL 6 deadline: July 2014.

Objective of Proposed Experiment

- Establish basic functionality of apparatus and procedures: measure VEMPs in multiple g levels, assess sensitivity and noise, validate user interface. Determine if recorded VEMPs are sensitive to changes in g level. (Flight week 1)
- Determine if proposed technology can detect adaptive changes over consecutive flights in naïve (non-adapted) subjects. (Flight week 2)

Technology Areas addressed by this technology: TA06: Human Health, Life Support and Habitation Systems